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METHODS AND SYSTEMS FOR PERFORMING CALL HANDOVER IN A MEDIA GATEWAY

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Description

METHODS AND SYSTEMS FOR PERFORMING CALL HANDOVER IN A MEDIA GATEWAY

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Technical Field

The present invention relates to methods and systems for performing call handover. More particularly, the present invention relates to methods and systems for controlling call handover functionality in a media gateway.

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Background Art

In mobile communications networks, a handover refers to the switching from one communications channel to another communications channel during the progress of a call. Such switching may occur, for example, when a mobile subscriber moves out of range of one base station and into the range of

15 another base station. Handover can also occur when a subscriber moves between antennas in the same base station.

In packet-based mobile communications networks, handovers must be performed not only on the radio interface, but also on the media gateway or gateways associated with the base stations involved in the handover. A media

20 gateway is a network entity that switches media stream communications between its input and output ports and may translate the media stream from

one format to another format. Media gateways do not participate in call signaling and consequently do not maintain call state information. A media gateway controller performs signaling functions to establish and tear down calls across media gateways. Thus, performing a handover in a media gateway can

5   include sending commands to the media gateway from one communications channel to another communications channel and freeing resources used by the old channel.

The MEGACO protocol, as described in ITU-T Recommendation H.248, includes commands for establishing contexts in a media gateway. A context is

10 analogous to a call or a communications session between one or more parties. In a media gateway, a context is defined by its endpoints, referred to as terminations. Typically, a context has two terminations in the media gateway – one for communications to and from one party and one for communications to and from another party.

15 One problem with providing handover support in some existing media gateways is that these media gateways utilize conference bridges to provide handover support. The conference bridge is used to establish the new communications channel to receive the call when the handover is performed. The new communications channel and the old communications channel exist

20 simultaneously in the conference bridge. When a handover occurs, the conference bridge switches the call to the new communications channel and frees resources associated with the old communications channel. While using a conference bridge provides one solution for performing handover in a media

gateway, conference bridges are expensive and are not scalable to meet increasing network demands.

Accordingly, in light of these difficulties associated with conventional media gateways and media gateway control protocols, there exists a need for

5   improved methods and systems for providing handover support in a media gateway.

Summary of the Invention

According to one aspect, the present invention includes methods and

10   systems for performing handover in a media gateway. In one exemplary implementation, the method includes creating a termination pair within the media gateway. The termination pair has a first termination configured as a primary termination and a second termination configured as a secondary termination. As used herein, a primary termination refers to a bi-directional

15   termination involved in a handover. A secondary termination refers to a receive-only termination involved in a handover. A normal termination refers to a bi-directional termination that is not involved in a handover. In the termination pair, the configurations of the first termination and second termination are modified such that the first termination is configured as the secondary

20   termination and the second termination is configured as the primary. The first termination may be removed.

The pairing of terminations and the switching of states of the various terminations involved in the termination may be accomplished using extensions to one of the standard media gateway control protocols. The extensions may

include commands that allow terminations to be paired with other terminations and commands that allow the state of a termination to be changed. Using these commands, a media gateway controller can easily control one or more media gateways to perform a media stream handover without using a

5   conference bridge.

Accordingly, it is an object of the invention to provide improved methods and systems for providing handover support in a media gateway.

It is another object of the invention to provide methods and systems for providing handover support in a media gateway without requiring a conference

10   bridge.

Some of the objects of the invention having been stated hereinabove, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

15   Brief Description of the Drawings

Preferred embodiments of the invention will now be explained with reference to the accompanying drawings of which:

Figure 1 is a block diagram of a media gateway that may be used to implement an embodiment of the invention;

20   Figures 2A-2D are a sequence of block diagrams of a media gateway before, during, and after a call handover in accordance with the invention has been performed;

Figure 3 is a flow chart of a call handover sequence in accordance with the invention;

Figure 4 is a signaling diagram of commands that may be used to implement an embodiment of the method for controlling handover in a media gateway in accordance with the invention;

Figure 5 is a block diagram of a handover scenario involving call
5   handover within a single media gateway;

Figure 6 is a block diagram of a handover scenario involving call handover from one media gateway and a second media gateway resulting in the addition of the second media gateway to the connection path;

Figures 7A and 7B are block diagrams of a handover scenario involving
10   call handover between a first media gateway and a second media gateway; and

Figure 8 is a block diagram of a handover scenario in a media gateway where a handover is initiated before a call is established according to an embodiment of the present invention.

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Detailed Description of the Invention

Figure 1 is a block diagram of a media gateway **101** that may be used to implement an embodiment of the invention. The media gateway **101** includes a control module **103** that functions as the command interface for a media
20   gateway controller **105**. Commands from the media gateway controller **105** are received and processed by the control module **103**. The control module **103** may, in turn, provide instructions to or acquire information from other modules within the media gateway **101** in order to comply with the commands from the media gateway controller **105**. According to the present invention, the

media gateway controller **105** may send commands to the controller **103** to effect handovers and termination pairings in accordance with the present invention. Exemplary commands and handover scenarios will be described in detail below.

5   The media gateway **101** may also include interfaces for sending and receiving media streams to and from a plurality of different types of networks. For example, the media gateway **101** may also include time division multiplexed (TDM) network interface cards **107**. TDM network interface cards **107** send and receive media streams from external TDM networks. TDM

10   network interface cards **107** may implement any suitable physical layer protocol for sending and receiving media streams over TDM links. For example, each TDM NIC **107** may terminate one or more TDM voice trunks.

In addition to TDM network interface cards, the media gateway **101** may include packet network interface cards **109**. Each packet network interface

15   card **109** may implement network layer functions and packet forwarding functions, including Internet protocol (IP) forwarding functions. In the illustrated example, different packet network interface cards are provided to connect to external Ethernet, Packet Over SONET (POS), and asynchronous transfer mode (ATM) networks.

20   In Figure 1, the media gateway **101** includes voice server modules **111**, which may include circuitry for implementing one or more voice over packet protocols, such as RTP. In order to switch packets from network interface cards **109** to the appropriate voice server module **111**, the media gateway **101**

includes a packet matrix module **113**. The packet matrix module **113** switches

packets under the control of the control module **103**. In addition to packet

matrix module **113**, media gateway **101** includes a TDM matrix module **115** for

switching data in TDM time slots between TDM NICs **107** and voice server

5   modules **111**. TDM matrix modules **115** are also controlled by control module

103.

Different handover scenarios involving one or more media gateways

will be described below. In the handover scenarios, the media gateways may

be similar in structure to media gateway **101** illustrated in Figure 1. However,

10   the present invention is not limited to performing the handover routines

described herein using a media gateway structure identical to that illustrated in

Figure 1. Any suitable media gateway capable of receiving commands from an

internal or external media gateway controller and establishing call contexts

based on the commands is intended to be within the scope of the invention.

15   Figures 2A-2D are a sequence of block diagrams of a media gateway

before, during, and after a handover sequence in accordance with the invention

has been executed. Figure 2A shows a media gateway **201** before handover is

initiated. The media gateway **201** includes a first termination **203** and a second

termination **205**. Although Figure 2A shows only two terminations, this is a

20   simplification. One skilled in the art would recognize that a media gateway

could have numerous terminations. A context **207** is established between the

first and second terminations **203, 205**, and permits bi-directional media stream

to flow between the terminations. A switching matrix **209** completes the

interconnection of the terminations **203, 205** and is considered part of the context.

As shown in Figure 2B, when the handover procedure is initiated, a third termination **211** is added to the existing context and is paired with the first termination **203**. The concept of termination pairing is novel to the invention. One feature of termination pairing is that a termination is created and paired with one termination of an existing context. Another feature of termination pairing is the nature of the communication link to each termination. One of the paired terminations, called the primary termination, maintains a bi-directional link with the unpaired (or normal) termination. The other paired termination, called the secondary termination, maintains a unidirectional, receive-only connection **213** with the normal termination. For example, in Figure 2B, the first termination **203** is the primary termination, the third termination **211** is the secondary termination, and the second termination **205** is the normal termination. It should be appreciated that end-user communication through the media gateway **201** is carried by the first termination **203** and the second termination **205** (i.e., the primary termination and the normal termination, respectively), since this is the only bi-directional path through the media gateway **201**.

The handover procedure is completed by modifying the context to make the third termination **211** the primary termination and the first termination **203** the secondary termination, as shown in Figure 2C. The bi-directional communication path through the media gateway **201** is now between the

second termination **205** and the third termination **211**, while the unidirectional, receive-only path is to the first termination **203**. Thus, end-user communication through the media gateway **201** is carried between the third termination **211** and the second termination **205**. Since the first termination

5 **203** is no longer needed, it is desirable to free-up resources by removing the first termination from the context, as shown in Figure 2D.

Figure 3 is a flow chart of a call handover procedure in accordance with the invention. A media gateway controller sending appropriate messages to one or more media gateways may perform the steps involved in the handover

10 procedure. The handover procedure may be performed after other call set-up messages and normally during the conversation phase of a call. Various techniques known to the art may be used to determine whether the handover procedure should be initiated.

In step **301**, the media gateway controller (MGC) adds a second

15 termination to the same context as a first termination. The association role of the second termination is set to secondary. The MGC also modifies the association role of the first termination from normal to primary. In step **303**, the MGC swaps the association role of both terminations. That is, the first termination is set to secondary and the second termination is set to primary. In

20 step **305**, the MGC modifies the association role of the second termination from primary to normal, and subtracts the first termination from the context.

It should be appreciated that the steps performed by the MGC may take the form of instructions from the MGC to the MG. The MG may respond to the instructions, for example, by acknowledging the receipt of the instruction or

signaling whether or not the instruction has been successfully executed. Figure 4 is a signaling diagram of commands that may be used to implement an embodiment of the method for controlling handover in a media gateway in accordance with the invention. The diagram shows messages from the MGC

5   to the MG and return messages from the MG to the MGC. It should be noted that the internal architecture of the MG may provide for various subsystems or modules and that a command received from the MGC may result in one or more messages between subsystems to perform the requested task.

In step **401**, the MGC instructs the MG to add terminations T1 and T2.

10   Both terminations are configured as normal terminations with send and receive capability. The terms "send" and "receive", as used herein, refer to sending and receiving information between terminations within a media gateway. In the MEGACO protocol specification, the terms "send" and "receive" refer to transfer of information to and from outside of a media gateway by a termination

15   in the media gateway respectively. The MG responds in step **403** that each command was successfully executed. Steps **401** and **403** may be performed as part of the initial call set-up.

At some point in during the call, the MGC determines that a handover is needed. In step **405**, the MGC instructs the MG to add termination T3 and pair

20   it with termination T1. Termination T3 is configured as a secondary termination with receive-only capability. The MGC also instructs the MG to modify the configuration of termination T1 by configuring it as a primary termination and pairing it with termination T3. In step **407**, the MG responds to the add and modify commands. In step **409**, the MGC instructs the MG to modify the

configuration of termination T3 to make it a primary termination with send and receive capability. The MGC also instructs the MG to modify the configuration of termination T1 to make it a secondary termination with receive-only capability. In step **411**, the MG responds to the modify commands. In step **413**, the MGC instructs the MG to modify the configuration of termination T3 to make it a normal termination and to subtract termination T1. The MG responds to the modify and subtract commands in step **415**.

The following examples of handover scenarios are provided to enhance the understanding of the invention as it is applied to various situations and should not be used to limit the scope of the claimed invention. It will be understood that in the following examples, media gateways, terminations, and call contexts are general perform as described above.

Example 1

Figure 5 is a block diagram of a call between User A **501** and User B **503**. The call is established through the media gateway **505** by creating a context **507** that includes a media stream between termination T1 **509** and termination T2 **511**. User A is connected to the media gateway **505** through termination T1 **509**. The connection may be, for example, through a wireless network, although the connection may be through any network that permits the user to change locations thereby requiring the media gateway to alter the media stream in order to maintain the call. User B **503** is connected to the media gateway **505** through termination T2 **511**. For this example, User B's connection may be either a wired or wireless connection. Termination T3 **513**

is similar to termination T1 **509**, although termination T3 **513** is not initially involved in the call and is not initially part of the call context. A switching matrix **515** switches media streams between terminations in media gateway **515**.

As User A **501** is moving outside of the area serviced by termination T1

5   **509**, provisions must be made to maintain the call connection to User B **503**. In accordance with the invention, the call context is modified to create a termination pair. The creation of the termination pair involves adding termination T3 **513** to the call context, designating termination T3 **513** as a secondary termination, and modifying the call context to designate termination

10   T1 **509** as a primary termination. Thus, the bi-directional media stream between termination T1 **509** and termination T2 **511** remains, while a receive-only media stream from termination T2 **511** to termination T3 **513** is established.

The handover operation from termination T1 **509** to termination T3 **513**

15   can be completed in two ways. First, the call context can be modified to designate termination T3 **513** as the primary termination and termination T1 **509** as the secondary termination. Thus, the bi-directional media stream is established between termination T3 **513** and termination T2 **511**. Termination T1 **509** is preferably removed to release gateway resources. The second way

20   to complete the handover operation is to subtract primary termination T1 **509** from the call context. Since termination T1 **509** is paired with termination T3 **513**, subtracting the primary termination implicitly modifies the remaining

paired termination to function as a normal termination with a bi-directional media stream.

Example 2

Figure 6 is a block diagram of a handover scenario involving call

5 handover from one media gateway to another media gateway. As in the previous example, User A **601** is engaged in a call with User B **603**. User A is serviced by termination T1 **605**, and User B is serviced by termination T2 **607**. Both termination T1 **605** and termination T2 **607** are associated with a call context **609** within media gateway MG1 **611**.

10 In this example, User A **601** is moving outside of the area serviced by media gateway MG1 **611** to an area serviced by media gateway MG2 **613**. Each media gateway includes a switching matrix **614** to switch media streams between terminations. In order to maintain the call between User A **601** and User B **603**, an association must be established between termination T1 **605** in

15 media gateway MG2 **613** and termination T2 **607** in media gateway MG1 **611**. As in the previous example and in accordance with the invention, the call context in media gateway MG1 **611** is modified to create a termination pair. The creation of the termination pair involves adding termination T3' **615** to the call context in media gateway MG1 **611**, designating termination T3' **615** as a

20 secondary termination, and modifying the call context to designate termination T1 **605** as a primary termination. In media gateway MG2 **613**, a call context **617** is established between termination Tc **619** and termination T3 **621**. In a communication network, bearer channels interconnect media gateways. Thus,

a connection between termination T3' **615** in media gateway MG1 **611** and termination Tc **619** in media gateway MG2 **613** is established in the conventional manner via a bearer channel **623**.

After the end-to-end communication path is established, the media

5   gateway controller may switch the role of termination T1 **605** and termination T3' **615** in media gateway MG1 **611**. Thus, the call context in media gateway MG1 **611** is modified to designate termination T3' **615** as the primary termination and termination T1 **605** as the secondary termination. Termination T1 **605** can then be removed from the call context to free network resources.

10   **Example 3**

Figure 7A is a block diagram of a handover scenario involving call handover from one media gateway and to another media gateway. As in the previous examples, User A **701** is engaged in a call with User B **703**. User A **701** is serviced by termination T1 **705** in media gateway MG1 **707**, and User B

15   **703** is serviced by termination T2 **709** in media gateway MG2 **711**. The media stream associated with the call context **713** in media gateway MG1 **707** and call context **715** in media gateway MG2 is carried by a bearer channel **717** between termination Ta **719** and termination Tb **721**.

In this example, User A **701** moves outside of the area serviced by

20   media gateway MG1 **707** and into an area serviced by media gateway MG2 **711**. It is assumed that each media gateway includes a switching matrix **712** to switch media streams between terminations. In order to maintain the call between User A **701** and User B **703**, an association must be established

between termination T1 **705** in media gateway MG2 **711** and termination T2 **709** in media gateway MG2 **711**. As in the previous examples and in accordance with the invention, the call context in media gateway MG1 **701** is modified to create a termination pair. The creation of the termination pair

5   involves adding termination T3' **723** to the call context in media gateway MG1 **707**, designating termination T3' **723** as a secondary termination, and modifying the call context to designate termination T1 **705** as a primary termination. In media gateway MG2 **711**, a call context **725** is established between termination Tc **727** and termination T3 **729**. A connection between

10   termination T3' **723** in media gateway MG1 **707** and termination Tc **727** in media gateway MG2 **711** is established in the conventional manner using a bearer channel **731**.

After the end-to-end communication path is established, the media gateway controller may switch the role of termination T1 **705** and termination

15   T3' **723** in media gateway MG1 **707**. Thus, the call context in media gateway MG1 is modified to designate termination T3' **723** as the primary termination and termination T1 **705** as the secondary termination. Termination T1 **705** can then be removed from the call context to free network resources.

Example 4

20   The solution provided in Example 3 results in the continued involvement of media gateway MG1 **701** in a call between two users serviced by media gateway MG2 **711**. This solution may not be practical in some situations, such as when resource usage should be optimized. Figure 7B is a block diagram of

an alternate solution to a handover scenario involving call handover between one media gateway and a second media gateway. In this example, termination T1 **705** in media gateway MG1 **707** supports User A **701** and termination T2 **709** in media gateway MG2 **711** supports User B **703**. A bearer channel **717**

5   between termination Ta **719** and termination Tb **721** carries the media stream between the two media gateways. As User A **701** moves into an area serviced by media gateway MG2 **711**, the handover procedure is initiated. In this example, termination T3 **729** is added to the call context **715** in media gateway MG2, with termination Tb **721** and termination T3 **729** forming a termination

10 pair. The call context **713** in media gateway MG1 **707** remains unchanged. Termination Tb **721** is configured as the primary termination and termination T3 **729** is configured as the secondary termination. As in the previous examples, termination Tb **721** and termination T3 **729** switch roles and termination Tb is subtracted from the call context. As a result, the call context in media gateway

15 MG2 provides a media stream between termination T2 **709** and termination T3 **703**, and resources in media gateway MG1 **707** are made available.

Example 5

The previous examples involve situations where call handover is initiated after a call has been established between User A and User B. Figure

20 8 depicts the situation where call handover is initiated before the call has been established or when it is not possible for a call to be established between User A and User B. User A **801** is connected to media gateway **803** through termination T1 **805**. User A **801** may wish to establish a connection with User

B (not shown) in a conventional manner, such as by dialing the telephone number assigned to User B. If the media gateway **803** is unable to establish the connection to User B, the media gateway **803** may signal this condition to User A **801** by transmitting a busy signal or other message toward User A **801**.

5   In this case, the media gateway **803** has established a context that includes only termination T1 **805**. The busy tone or announcement generated by the media gateway **803** and received by User A **801** is generated in a conventional manner by an announcement server **807** located within the media gateway **803**.

10   As in the previous examples, User A **801** begins to move outside of the area served by termination T1 **805**. Provisions must be made to maintain the connection to User A **801** so that User A **801** can continue to receive the busy signal or announcement message. In accordance with the invention termination T2 **809** is added to the context paired with termination T1 **805**, and

15   designated as the secondary termination. The context is also modified to designate termination T1 **805** as the primary termination. Because User A **801** is only receiving information from the media gateway, the media stream directed toward User A may be a one-way media stream. In this case, both the primary termination and the secondary termination may be configured as

20   receive-only terminations. Thus, modification of the direction of either media stream may not be necessary. Handover can be completed by removing termination T1 **805** from the context and leaving termination T2 **807** as the only termination in the context.

It should be appreciated that handover involving a single user in the context may occur at any point during the establishment of a call. For example, User A **801** may move from the area served by termination T1 **805** to the area served by termination T2 **807** after User A **801** has finished dialing a phone

5   number but before a connection has been established. In this case, the media gateway **803** may be transmitting ring-back tones toward User A **801** to indicate that call establishment is proceeding.

Thus, the present invention includes methods and systems for providing handover support in a media gateway. The methods and systems include the

10   concept of termination pairing whereby a new termination can be created and paired with an existing termination for handover purposes. In accordance with one exemplary new handover implementation, the new termination added to the context is initially receive-only. After the new termination is established, the media gateway controller may reverse the roles of the new termination and the

15   termination involved in the handover such that the new termination becomes send and receive and the termination involved in the handover event becomes receive-only. The termination involved in the handover event is then removed from the context. Thus, by providing the ability to pair terminations with existing terminations, the present invention provides a method for media stream

20   handover in a media gateway without requiring the use of a conference bridge.

The invention has been described with respect to exemplary embodiments and examples, which are intended to be illustrative, not restrictive. In light of this disclosure, those skilled in the art will likely make alternate embodiments of this invention.   These and other alternate

5   embodiments are intended to fall within the scope of the claims that follow.